

3 – Northern Indiana Exceptional Events Detail

Parameter: PM_{2.5}

Dates: May 23, 24, 29-31, 2007

Location: South Bend / Elkhart – St. Joseph & Elkhart Co.

Event: Smoke from wildfires in northern Florida and southern Georgia impacted the South Bend region during the period of May 23 – 31. The gradual buildup of smoke moving through the area during this period resulted in an exceedance of the 24-hour PM_{2.5} NAAQS on May 29th at South Bend Nuner (18-041-0014) and several elevated reading throughout the region.

Data: Different analyses of the data are used to demonstrate that the PM_{2.5} concentrations measured from May 23 – 31 are beyond the range of values typically found during that time period and that they have been influenced by outside events. Table 3.1 shows daily PM_{2.5} averages prior to, during, and after the event with the values flagged in **bold**. Data have been flagged with an exceptional event flag of ‘E’ in AQS, awaiting concurrence from EPA.

Tables 3.2 and 3.3 list summaries of the data collected at the South Bend / Elkhart sites since 2000. Summary data from 2007 and the annual and daily design values for 2005-2007 are calculated with all current data and with the flagged data removed. There is a significant improvement in the Elkhart 98th percentile design value (2005-2007) from 34 ug/m³ to 33 ug/m³ and an improvement in all of the annual averages when the flagged data is removed.

The values recorded during the May 24-31 time period are outside the normal values collected during the month of May. Prior to this time, the highest value reported at South Bend in May had been 27.5 ug/m³ and the highest monthly average had been 14.2 ug/m³. With the high data collected in May 2007, the highest value was 37.1 ug/m³ and the monthly average was 14.7 ug/m³. Removing the flagged data results in a maximum daily concentration of 18.8 ug/m³ and an average concentration of 10.2 ug/m³. Prior to this time, the highest value reported at Elkhart in May had been 24.7 ug/m³ and the highest monthly average was 15.5ug/m³. With the high data collected in May 2007, the highest value was 34.7 ug/m³ and the monthly average was 14.5 ug/m³. Removing the flagged data results in a maximum daily concentration of 17.5 ug/m³ and an average concentration of 10.3 ug/m³. These values are much more in line with historical data.

**Table 3.1 - FRM Daily Values
Exceptional Event Period**

Values in **BOLD** are flagged as exceptional events

Date	S. Bend - Shields 18-141-0015	S. Bend - LaSalle 18-043-1004	S. Bend - Nuner 18-141-0014	Elkhart - P. Moran 18-039-0003
5/17/07			3.9	4.3
5/18/07		7.4	8.7	7.9
5/19/07			8.4	9.2
5/20/07			9.7	10.9
5/21/07		11.1	11.8	11.4
5/22/07			18.8	16.6
5/23/07			33.9	32.8
5/24/07	28.6	28.7	31.7	30.9
5/25/07			10.6	11
5/26/07			18.3	17
5/27/07	11.7	10.2	13.7	15.5
5/28/07			15.3	16
5/29/07			37.1	34.7
5/30/07	30.8	31.3	34	32.8
5/31/07			32	31.3
6/1/07				22
6/2/07				

Table 3.2 - Historical Daily Values

		South Bend CAAP 181410008 / 1005		South Bend Nuner 181410014		South Bend LaSalle 181412004		Elkhart P. Moran 180390003	
Year		98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹
2000		30.2		29.5		30.4		38.6	
2001		37.6		34.5		36.8		37.5	
2002	2000- 2002	32.8	34	31.7	32	31.3	33	35.2	37
2003	2001- 2003	34.8	35	35	34	33.3	34	36.7	36
2004	2002- 2004	27.4	32	26.7	31	25.1	30	31.4	34
2005	2003- 2005	37.3	33	40.2	34	35.8	31	40.8	36
2006	2004- 2006	24.7	30	26	31	24.1	28	25.5	33
2007	2005- 2007	30.8	31	33.8	33	31.3	30	34.6	34
2007	2005- 2007	30.2	31	31.9	33	30.5	30	33.2	33

¹Daily Design Value = 3 year average of annual 98th %ile values.

Table 3.3 - Historical Annual Averages

		South Bend CAAP 181410008 / 1005		South Bend Nuner 181410014		South Bend LaSalle 181412004		Elkhart P. Moran 180390003	
Year		Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²
2000		14.1		13.8		13.8		15.7	
2001		14.7		14		14.5		15.7	
2002	2000- 2002	14.4	14.4	14.3	14	13.9	14.1	15	15.5
2003	2001- 2003	13.8	14.3	13.8	14	13.5	14	14.9	15.2
2004	2002- 2004	12.5	13.6	12.3	13.5	11.7	13	13.3	14.4
2005	2003- 2005	14.8	13.7	14.8	13.7	14.5	13.2	15.6	14.6
2006	2004- 2006	11.8	13	12.4	13.2	11.3	12.5	12.6	13.8
2007	2005- 2007	12.9	13.2	12.9	13.4	12.4	12.8	13.8	14
		Values excluding flagged data							
2007	2005- 2007	12.5	13	12.6	13.3	12.1	12.6	13.5	13.9

²Annual Design value = 3 year average of the annual averages.

Particulate Composition: Speciation data are collected at the Elkhart Pierre Moran site on a one in six day sampling schedule. Data are available for May 24 and May 30. High organic carbon values were reported on those two dates; 7.5 ug/m³ and 8.2 ug/m³ respectively. These values were the fourth and the fifth highest values of the year. The annual average for organic carbon at this site is 4.0 ug/m³. There was no significant increase in the elemental carbon values; 0.65 ug/m³ and 1.1 ug/m³, on these two dates, as compared to the annual average of 0.67 ug/m³. The high organic carbon values, without an increase in elemental carbon, are a very good indicator of biomass combustion. Appendix 3 illustrates the rise and fall of the regional organic carbon values.

Maps: Images of maps from NOAA Satellite and Information Services show the smoke plume originating from the northern Florida/southern Georgia region. Dispersion and movement of the smoke plume from these fires was generally to the west or northwest and then to the north. The daily satellite smoke photos show that the smoke plume from the fires extends statewide on May 23 and 24. The plume recedes farther to the south and east until May 29. It continues to influence all sites statewide until May 31. The daily wind roses (obtained from the meteorological site at South Bend – Shields Dr. (18-141-1005) show information on prevailing wind direction, calm conditions and wind speed. NOAA weather maps are also used to

show that an upper level trough greatly influences the direction of the plume in relation to the South Bend region.

Trajectory Modeling: The NOAA HYSPLIT Models are used to show wind trajectories at different levels during this event. Backward modeling from the site (latitude: 41.70°; longitude: -86.21°) at elevations of 25m, 150m and 500m was conducted for a period of three (3) to four (4) days prior. The differing elevations were chosen to demonstrate the air mass's uniformity at ground-level where the samplers were located and aloft which avoids the ground-level limitations of the model. Forward modeling was conducted using the Bugaboo Scrub Fire as the starting point (latitude: 30.70°; longitude: -82.40°) at an elevation of 250 meters (appropriate height that is low enough to always be in the well-mixed zone and high enough to avoid the ground-level model limitation) and going three (3) to four (4) days. Overall, there is a very good correlation when comparing the forward and backward trajectories for a given date. For example, May 24 shows a very narrow channel of air flow between southeastern Georgia and northern Indiana. Both the backward and forward trajectories confirm this. Forward trajectory modeling can be found in Appendix 2.

Conclusion: EPA defines an “exceptional event” as an unusual or naturally occurring event that can affect air quality but is not reasonably controllable by state and local agencies. Exceptional events are events for which the normal planning and regulatory process established by the clean air act is not appropriate. Indiana has illustrated through the use of maps, meteorological data, speciation data, trajectory models and historical data that the smoke from wildfires in Florida and Georgia impacted the South Bend region on May 23, 24, 29 – 31, 2007 causing an exceedance of the PM_{2.5} 24-hour standard and significantly increasing the annual average. According to 40 CFR Part 50.14 (b)(1), “EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA’s satisfaction that an exceptional event caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section.” IDEM believes they have successfully illustrated the impact of this event on the sites in this region.

Therefore, IDEM requests that EPA concur with the ‘E’ flag on the data in AQS for the data in **bold** in Table 3.1.

NOAA Satellite Smoke Maps, Weather Maps, and Wind Roses

The smoke map shows that the plume has reached the South Bend / Elkhart area and as shown in Table 1, PM_{2.5} levels have started to increase. The corresponding wind rose and weather map further illustrate the direction of the plume by the location of the upper level trough (orange dashed line) and the S, SE prevailing winds.

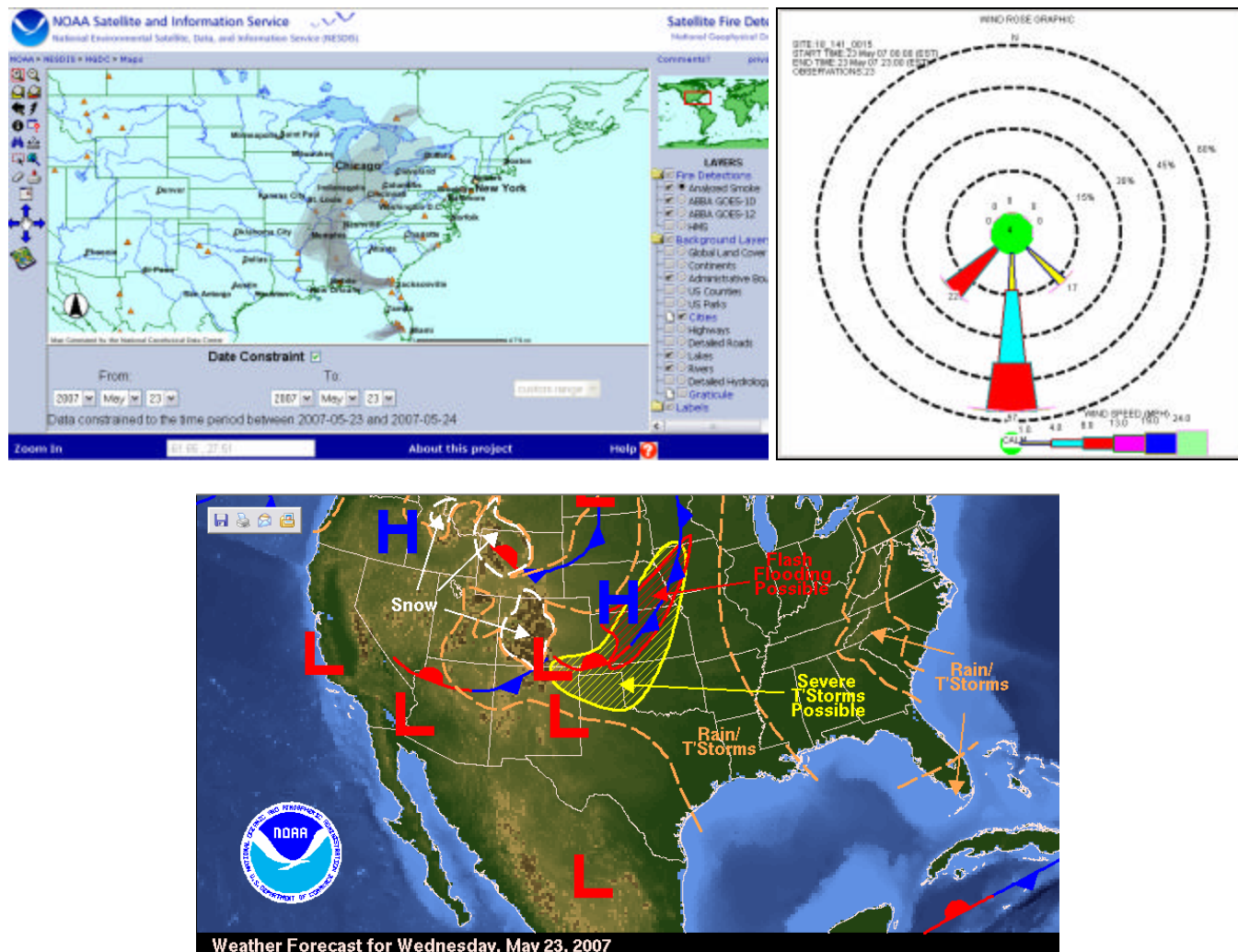


Figure 3.1 - May 23, 2007

The smoke map shows that the plume is remaining over the area. The prevailing wind direction continues to be directly from the south as the upper level trough moves further to the east and another trough develops over Ohio, keeping the plume over the northern Indiana region.

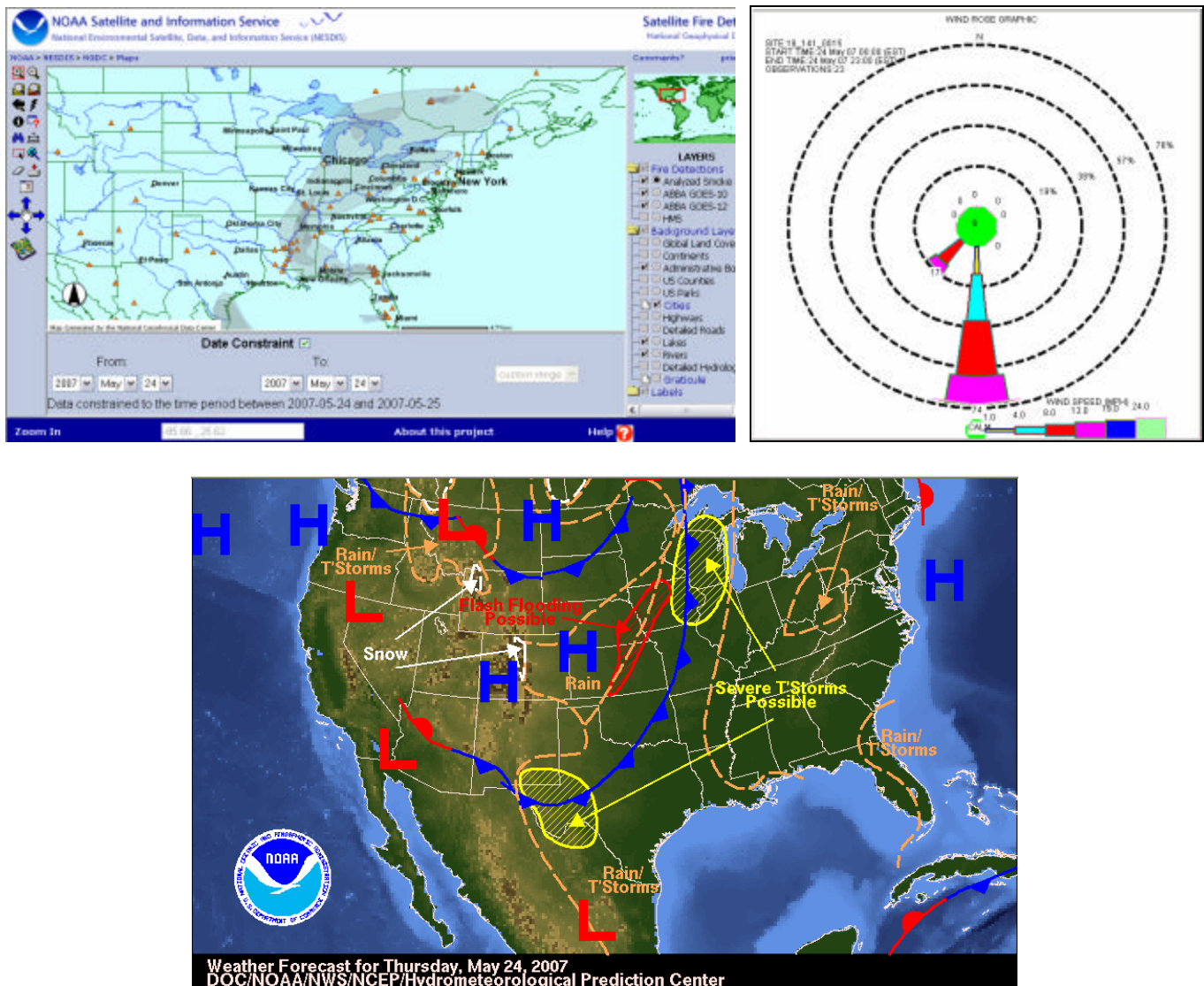


Figure 3.2 - May 24, 2007

Although the map illustrates the plume is not over the region, the prevailing SE wind direction, as shown by the wind rose, keep the high levels of $PM_{2.5}$ over the area.

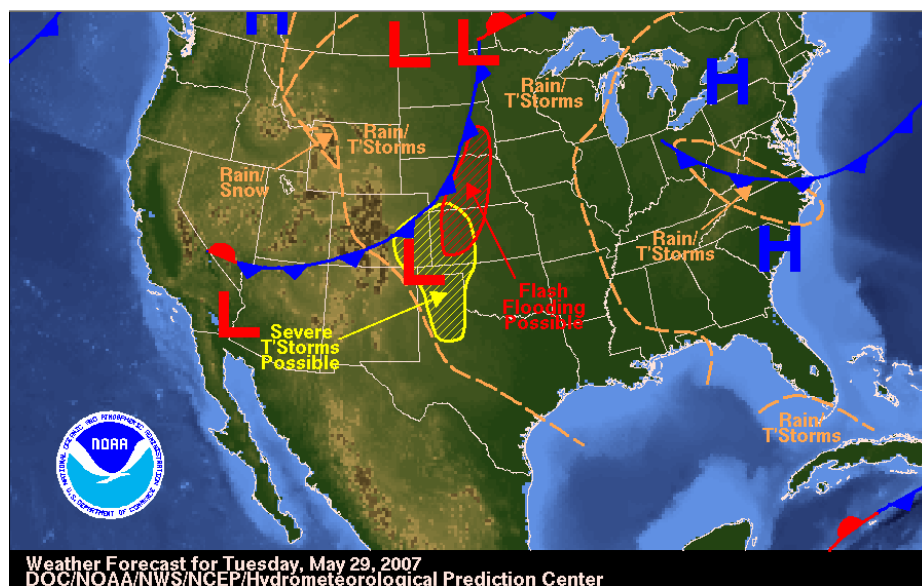
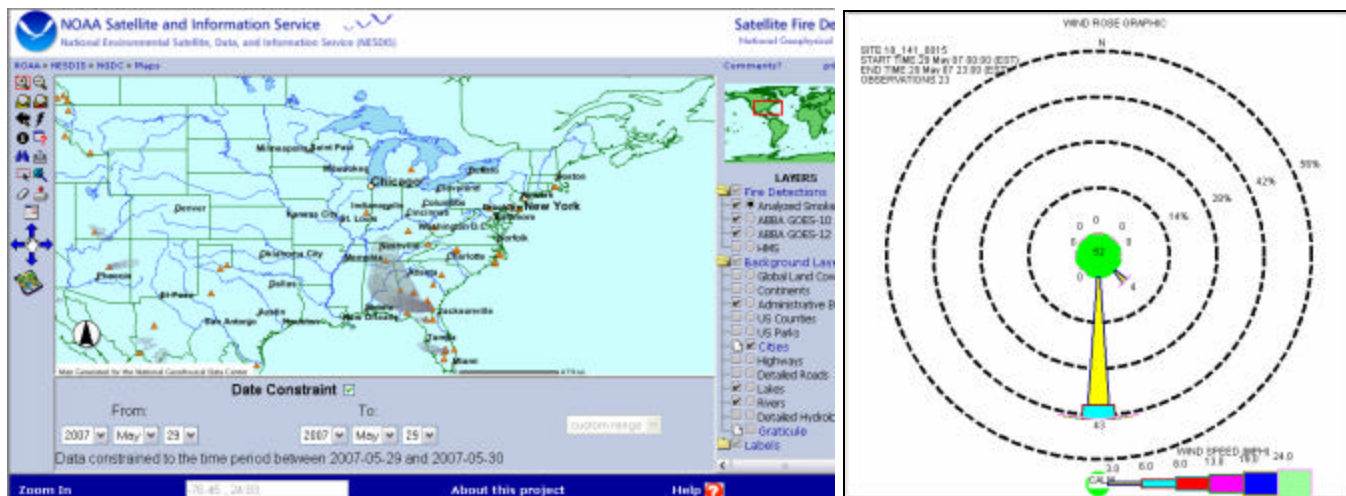


Figure 3.3 - May 29, 2007

The map shows the plume has moved back over the region as the upper level trough dips down over the area and the wind direction continues to be from the S, SW.

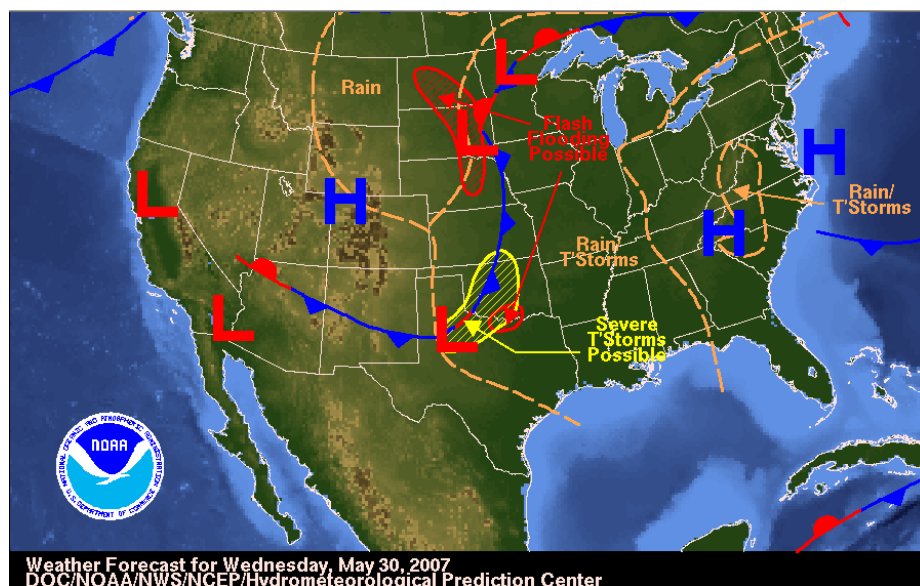
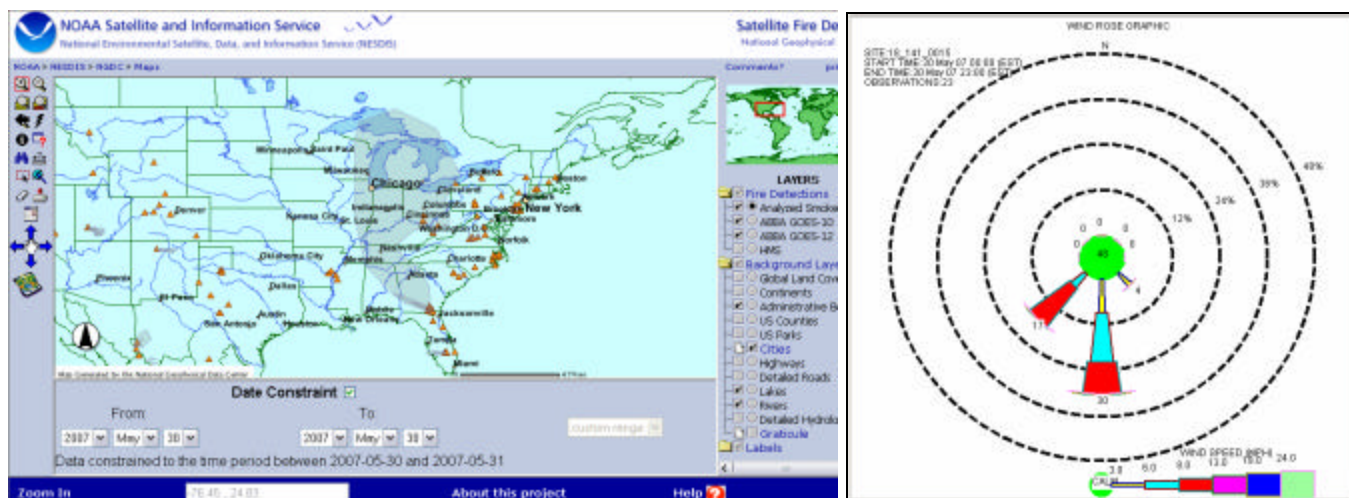


Figure 3.4 – May 30, 2007

The map shows the plume has dissipated as the upper level trough moves to the east. However, calm wind conditions and a southerly wind direction keep the high levels over the area.

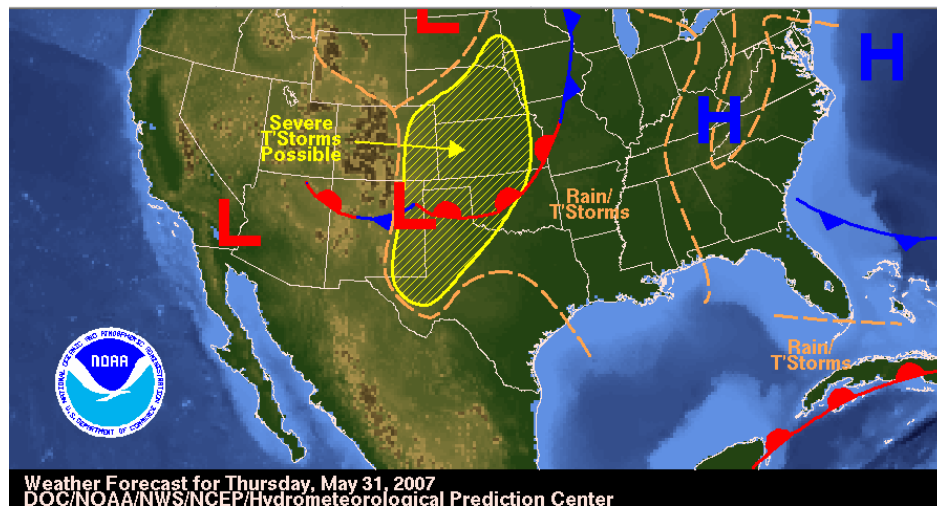
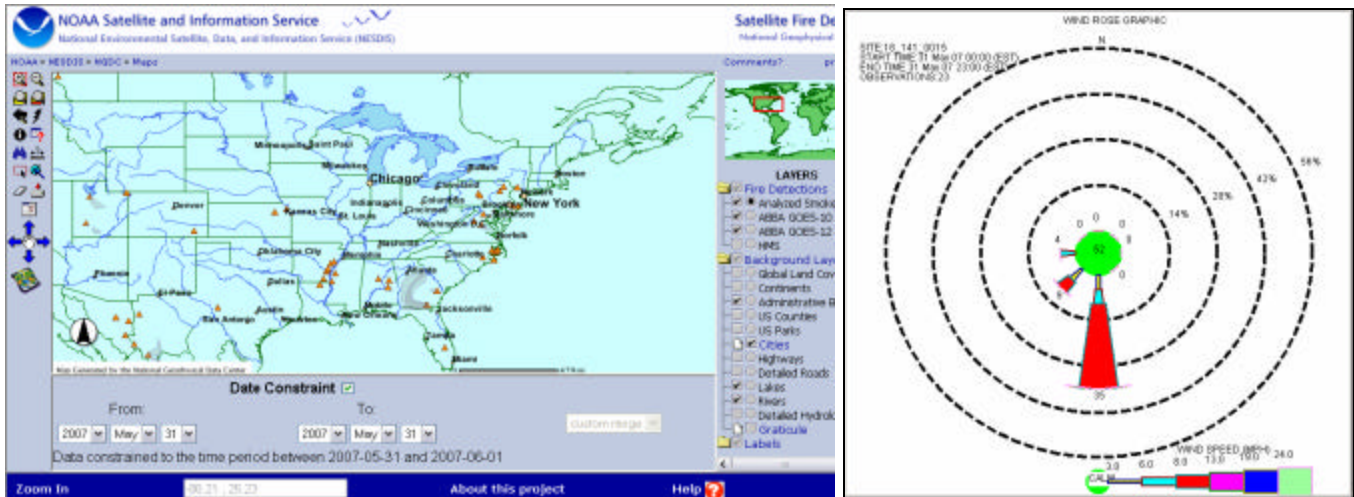


Figure 3.5 – May 31, 2007

Backward Trajectory Models

NOAA ARL READY HYSPLIT Maps

Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://www.arl.noaa.gov/ready/hysplit4.html>). NOAA Air Resources Laboratory, Silver Spring, MD.

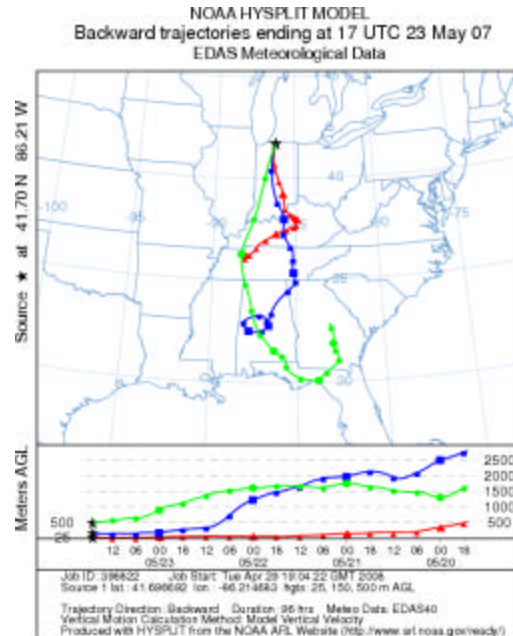


Figure 3.6: Backward trajectories originating from South Bend on 5/23/07 at 12:00 PM EST showing the air mass originating from southern Georgia.

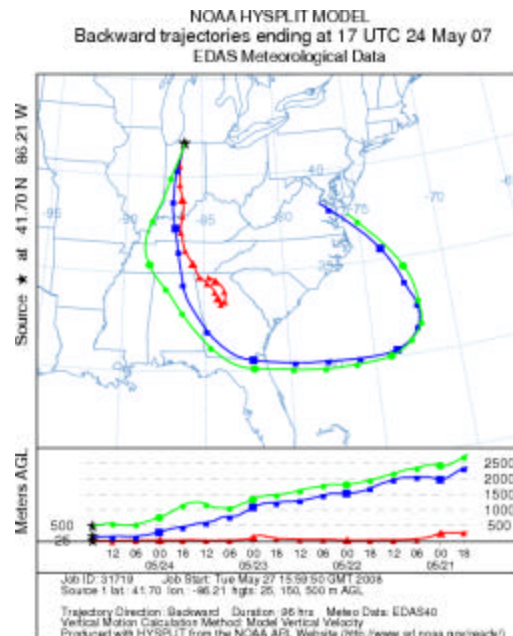


Figure 3.7: Backward trajectories originating from South Bend on 5/24/07 at 12:00 PM EST showing continuation of the air mass passing over southern Georgia and northern Florida.

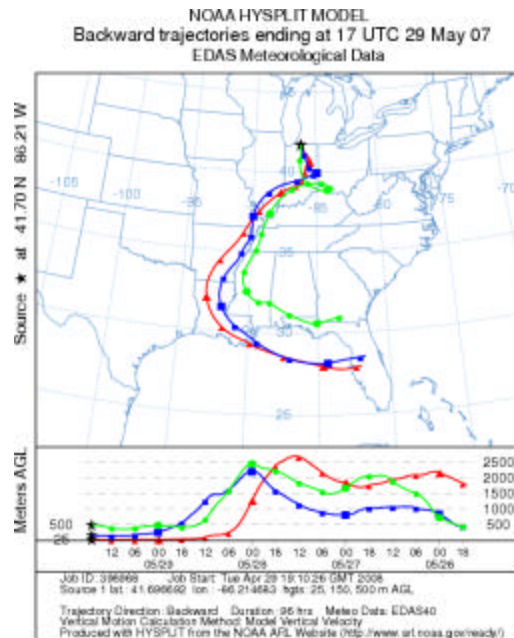


Figure 3.8: Backward trajectories originating from South Bend on 5/29/07 at 12:00 PM EST showing consistency in the air mass passing over southern Georgia and northern Florida.

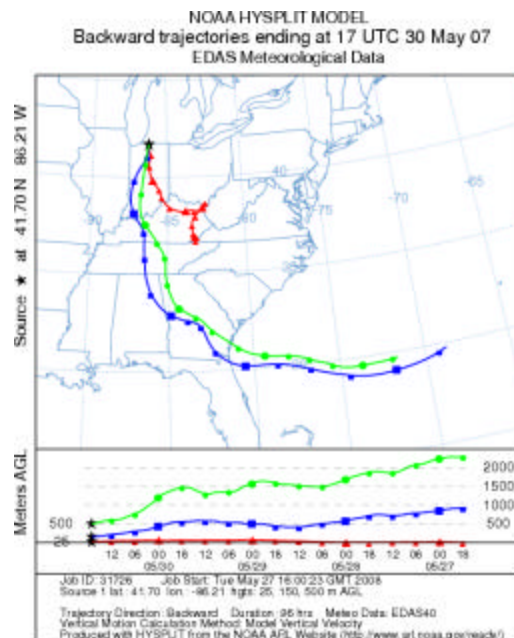


Figure 3.9: Backward trajectories originating from South Bend on 5/30/07 at 12:00 PM EST showing consistency in the air mass passing over southern Georgia and northern Florida.

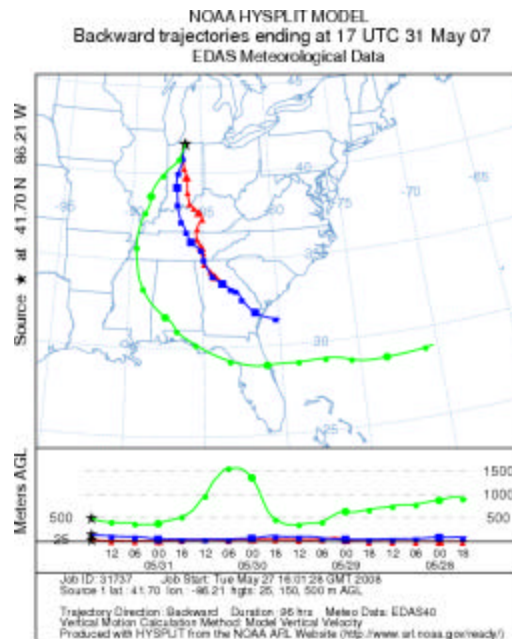


Figure 3.10: Backward trajectories originating from South Bend on 5/31/07 at 12:00 PM EST showing the air mass still passing over southern Georgia and Florida.